Department of Environmental Quality
Northwest Region Portland Office

March 21, 2008 *Also Sent Via E-mail*

Mr. Robert J. Wyatt
Northwest Natural Gas Company
220 N.W. Second Avenue
Portland, OR 97209

Subject: Groundwater/DNAPL Focused Feasibility Study
Shoreline Segments 1 and 2, NW Natural Property and the Northern Portion of the Siltronic Corporation Property
Northwest Natural Gas Company
Portland, Oregon
ECSI No. 183

Dear Mr. Wyatt:

The Department of Environmental Quality (DEQ) reviewed the "Groundwater/DNAPL Source Control Focused Feasibility Study – NW Natural 'Gasco' Site," received October 12, 2007 and amended November 9, 2007 (Groundwater/DNAPL FFS). Anchor Environmental, LLC prepared the Groundwater/DNAPL FFS on behalf of the Northwest Natural Gas Company (NW Natural). The Groundwater/DNAPL FFS presents NW Natural's evaluation of removal action (i.e., source control measures [SCMs]) alternatives to mitigate migration of groundwater contamination and the movement of dense non-aqueous phase liquids (DNAPLs) to the Willamette River and its sediments. The document also includes a proposal for stabilizing riverbank soils along the shoreline of the property owned by NW Natural (NW Natural Property, or the "Gasco Site"). NW Natural has developed the Groundwater/DNAPL FFS consistent with DEQ Voluntary Agreement No. WMCVC-NWR-94-13 (dated August 8, 1994) as amended by Addendum #1 dated July 19, 2006 (collectively referred to as the "MGP Agreement" in this letter). Under the MGP Agreement, NW Natural is expected to: 1) conduct a remedial investigation (RI) and feasibility study (FS) of releases of manufactured gas plant (MGP) waste[1] and associated contamination (MGP contamination) on the NW Natural Property and the adjoining Siltronic Corporation (Siltronic) property (Siltronic Property); and 2) identify and evaluate SCMs for unpermitted discharges or releases of hazardous substances from the NW Natural Property to the Willamette River.

The primary purpose of this letter is to inform NW Natural that based on our review of the Groundwater/DNAPL FFS and supporting documents, DEQ approves NW Natural's recommendation to implement a hydraulic control/containment system along the shoreline of the NW Natural Property and the northern portion of the Siltronic Property in combination with a vertical barrier in the southern portion of the NW Natural Property to mitigate migration of contamination to the Willamette River by: 1) MGP DNAPL in the fill water-bearing zone (WBZ) and alluvial WBZ; and 2) groundwater in the alluvial WBZ contaminated by dissolved MGP constituents. NW Natural's recommended SCMs alternatives also include contaminants associated with releases from the Siltronic Property where these chemicals have commingled with MGP DNAPL and/or groundwater contaminated by MGP constituents. DEQ does not approve NW Natural's riverbank stabilization proposal.

[1] MGP waste includes production waste and byproducts including, but not necessarily limited to, lampblack, purifier box wastes (spent lime and spent oxides), tar sludge, tar/oil/light oil, tar/oil/water emulsions, and naphthalene.

DEQ approval of NW Natural recommended SCMs alternatives is subject to the conditions detailed in this letter. In addition, this letter provides a brief discussion of DEQ's expectations regarding source control and the upland final remedy; background on the investigative and regulatory status of the NW Natural Property and the northern portion of the Siltronic Property; and DEQ's general and specific comments regarding the Groundwater/DNAPL FFS, including our rational for denying the riverbank stabilization proposal.

Regarding DEQ's expectations of NW Natural for source control and the final upland remedy, several years ago DEQ prioritized source control over the upland RI/FS. The source control strategy involved implementation of source control as a removal action (i.e., interim remedial action measure) in an attempt to cut-off DNAPL and MGP contamination being transported from the uplands to the river via groundwater. Successful timely source control would allow in-water actions to proceed without the immediate risk of recontamination from an uncontrolled upland source. DEQ has always envisioned a second phase of the strategy, a site-wide RI/FS resulting in a comprehensive final remedy.

NW Natural will find in EPA's attached comment letter, concern with the long-term effectiveness of the SCMs alternatives recommended in the Groundwater/DNAPL FFS. EPA strongly believes source area reduction, treatment and/or containment is necessary to ensure the long-term effectiveness of SCMs. DEQ largely agrees with EPA, but believes uplands source area work should be considered in the site-wide RI/FS, and that the recommended SCMs alternatives, subject to DEQ's conditions and comments, should be selected, designed, and constructed as soon as possible (as a removal action, not a site-wide final remedy).

BACKGROUND

Consistent with the MGP Agreement, NW Natural is conducting an RI/FS of the Gasco Site and the Siltronic Property. For the Gasco Site, NW Natural has submitted an RI Report[2] and Baseline Risk Assessment[3] that describe the magnitude, nature and extent of MGP waste and contamination in soil and groundwater and evaluate human health and ecological risks resulting from MGP contamination. Both documents are undergoing review by DEQ.

Historically, NW Natural (then known as Portland Gas & Coke [PG&C]) operated an oil MGP, known as the "Gasco Facility," on the NW Natural Property from 1912 until 1956. The Gasco Facility historic production areas corresponded roughly to the locations of the current NW Natural liquid natural gas plant, and the Koppers, Inc. (Koppers) and Fuel and Marine Marketing leaseholds. The Gasco Facility produced MGP waste that was placed in piles (lampblack, spent oxide, and gas purifier piles) and discharged to ponds (effluent discharge, settling, storage, and overflow ponds) located in non-production areas of the Gasco Facility. PG&C also owned much of the current Siltronic Property, the northern-most portion of which was used as an effluent pond during the later stages of the Gasco Facility operations.

Site investigations conducted to date in the uplands and offshore[4] areas of the Gasco Site by NW Natural, and in the northern portion of the Siltronic Property by Siltronic have determined that: 1) the general geology of the area of investigation consists of highly variable fill material overlying alluvium consisting of an upper fine-grained silt unit and deeper mixtures of predominantly fine and medium sands; 2) the fill unit

[2] Hahn and Associates, Inc., 2007, "Remedial Investigation Report, NW Natural - Gasco Facility, 7900 NW St. Helens Road, Portland, Oregon," April 30, a report prepared for NW Natural.
[3] Anchor Environmental, LLC, 2004, "Revised Baseline Ecological and Human Health Risk Assessment Report, NW Natural 'Gasco' Site," December, a report prepared on behalf of NW Natural.
[4] Anchor Environmental, LLC, 2008, "Offshore Investigation Report – NW Natural 'Gasco Site'," February, a report prepared for NW Natural and in review by EPA and DEQ.

is heavily contaminated by MGP waste throughout the former Gasco Facility production and waste management areas; 3) mobile DNAPL occurring in the fill unit and upper silt unit has penetrated into the alluvium beneath the former effluent storage, settling, and overflow ponds (former effluent ponds), and discharge areas; 4) DNAPL occurring in fill and alluvium has a high potential to migrate into the Willamette River in the southern portion of the Gasco Site; 5) in the northern portion of the Siltronic Property, DNAPL associated with a former "effluent pond overflow area" (EPOA) has migrated horizontally towards the river and vertically downward to depths below the bottom of the river channel; 6) MGP waste and contamination have impacted groundwater occurring in the fill (fill WBZ) and underlying alluvium (alluvial WBZ); 7) the fill WBZ and alluvial WBZ are complete groundwater contaminant transport pathways from the uplands to the Willamette River; 8) dissolved MGP constituents are present in groundwater and transition zone water (TZW) at concentrations that significantly exceed relevant Joint Source Control Strategy[5] (JSCS) screening criteria; and 9) historic direct discharge and deposition of MGP contamination has resulted in extensive impacts to river sediments offshore of the NW Natural Property and the northern portion of the Siltronic Property.

NW Natural is moving forward with an RI of MGP waste and associated contamination on the Siltronic Property (Siltronic MGP RI) under a work plan[6] approved by DEQ. The scope of work for the Siltronic MGP RI includes further assessing the nature and extent of MGP waste and contamination and evaluating potentially complete and/or significant human health and ecological exposure pathways in the uplands of the Siltronic Property and to offsite areas, including the Willamette River and Doane Creek.

In addition to MGP waste and contamination on the NW Natural and Siltronic properties, releases from Siltronic's operations have occurred in the northern portion of the Siltronic Property. These releases originated from a former solvent underground storage tank system (Former UST System) and involved trichloroethene (TCE) formerly used by Siltronic, including its breakdown products and additives (collectively referred to as "VOCs" in this letter). Consistent with DEQ Order No. VC-NWR-03-16 (the VOC Order) dated February 5, 2004, Siltronic has conducted a VOC RI[7] that evaluated the lateral and vertical extent of VOCs in soil and groundwater in the uplands; and river sediment, TZW, and groundwater off-shore of the northern portion of the Siltronic facility. The VOC RI also evaluates the potential risk to human health and ecological receptors from exposure to VOCs in soil, river sediment, groundwater, and surface water.

The VOC RI Report documents that: 1) historic releases of VOCs from the Former UST System have impacted the alluvial WBZ beneath the northern portion of the Siltronic facility (i.e., the "VOC Plume"); 2) the VOC Plume has commingled with MGP DNAPL and groundwater impacted by dissolved MGP constituents; 3) groundwater is a complete contaminant transport pathway from the Former UST System to the Willamette River; 4) VOCs are present in groundwater and TZW under the Willamette River at concentrations that exceed JSCS screening criteria, and; 5) significant VOC sediment contamination (i.e.,

[5] EPA and DEQ, 2005, "Portland Harbor Joint Source Control Strategy – Final," December (note Table 3-1 revised July 16, 2007), a guidance document prepared jointly by the US Environmental Protection Agency and Oregon Department of Environmental Quality.
[6] Hahn and Associates, Inc., 2007, "Final Remedial Investigation Workplan, Historical Manufactured Gas Plant Activities - Siltronic Corporation Property, 7200 NW Front Avenue, Portland, Oregon," October 19, a work plan prepared for NW Natural.
[7] Maul Foster Alongi, Inc., 2007, "Remedial Investigation Report, Siltronic Corporation – Portland, Oregon," April 16, a report prepared on behalf of the Siltronic Corporation.

Area 2[8]) is present in the Willamette River within approximately 50 feet northeast of Siltronic's combined storm water/treated wastewater line (i.e., Outfall 001).

Source Control Determination

Based on work completed by NW Natural and Siltronic, DEQ determined that the shoreline of the Gasco Site and the northern portion of the Siltronic Property are high priorities for source control. The portion of the shoreline identified as the highest priority for source control (Segment 1) extends from downstream of the "Tar Body Removal Area"[9] (TBRA) on the NW Natural Property, to upstream of the EPOA on the Siltronic Property. This segment coincides with the heaviest MGP-related impacts identified near the river, including DNAPLs, impacted riverbank soils, and contaminated groundwater. It also includes the portion of the Siltronic Property where groundwater contamination caused by Siltronic has commingled with MGP-related DNAPL and groundwater contamination resulting from the former operations of the Gasco Facility. The segment of NW Natural's shoreline between the TBRA and NW Natural's downstream property line with US Moorings (Segment 2) is considered a high priority for source control primarily due to the presence and concentrations of MGP chemicals of interest (COI), particularly cyanide, in riverbank soils and groundwater. A third shoreline segment (Segment 3) extends from upstream of the EPOA to the upstream Siltronic Property line. A source control evaluation of Segment 3 is ongoing.

NW Natural and Siltronic Focused Feasibility Studies

The Groundwater/DNAPL FFS evaluates and recommends SCMs alternatives along shoreline segments 1 and 2 to mitigate contamination migrating to the Willamette River including, MGP DNAPL in the fill WBZ and alluvial WBZ and groundwater in the alluvial WBZ contaminated by dissolved MGP constituents. The document also includes a proposal to repair and/or stabilize riverbank soils along the shoreline of the NW Natural Property.

The Groundwater/DNAPL FFS evaluates SCM alternatives prior to initiation of the MGP FS. The document does not propose final remedial action(s) for MGP waste and/or MGP contamination occurring in the Gasco Site and Siltronic Property uplands. The final remedial action(s) for MGP waste and contamination will be selected as an outcome of the uplands MGP RI/FS for the NW Natural and Siltronic properties. DEQ considers implementation of SCMs necessary to control ongoing and future migration of DNAPL and contaminated groundwater to the river during the time the uplands RI/FS is being completed and in-water actions are being planned.

Regarding the VOC Plume in the northern portion of the Siltronic Property, per the VOC Order, Siltronic submitted a VOC Plume FFS[10] that evaluated and recommended SCMs alternatives for the northern portion of the Siltronic Property to mitigate VOC contamination migrating to the Willamette River and its sediments via the groundwater pathway. The geographic area covered by the VOC Plume FFS overlaps with the Groundwater/DNAPL FFS in the northern portion of the Siltronic Property where commingling of MGP DNAPL, MGP contamination, and VOCs has occurred.

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[8] Based on uplands and in-water investigations completed to date, Area 2 does not appear to be associated with the VOC Plume. Siltronic suspects Area 2 is the result of historic releases to the storm water conveyance system from a TCE stripper system formerly used at the facility.

[9] The "Tar Body Removal Area" is a features associated with the historic operation of the former Gasco Facility. The TBRA was subject to an EPA early action conducted in the late-summer/early-fall 2005.

[10] Maul Foster and Alongi, 2007, "Focused Feasibility Study - Siltronic Corporation, Portland, Oregon" October 23 (amended December 19, 2007), a document prepared for Siltronic, Corporation.

The VOC Plume FFS evaluated six SCMs alternatives that fell under four general categories: 1) no action; 2) use of enhanced in-situ bioremediation (EIB) treatment technologies along the riverbank and in the vicinity of the Former UST System; 3) use of EIB in the Former UST System vicinity combined with hydraulic containment along the shoreline; and 4) hydraulic containment alone along the shoreline. In a letter dated February 14, 2008, DEQ selected SCMs alternatives for the VOC Plume that involve use of EIB in the Former UST System vicinity (i.e., the source of the VOC release[s]) combined with hydraulic control and containment along the shoreline.

DEQ informed Siltronic they should move forward with the work necessary to scale-up EIB in the vicinity of the Former UST System and contribute to planning and implementation of contaminant migration control and containment SCMs along the riverbank. Particular attention will be paid by Siltronic to portions of the VOC Plume that could occur outside the control/containment SCMs being evaluated by NW Natural (i.e., VOCs occurring beyond the margins of MGP contamination).

Neither the Groundwater/DNAPL FFS nor the VOC Plume FFS address contamination resulting from historic discharges and/or deposition of MGP waste, MGP contamination, and/or VOCs in the Willamette River. NW Natural and Siltronic acknowledge that offshore contamination will require in-water action(s) that are beyond the scope of either FFS. Impacts to the Willamette River and its sediments requiring in-water action(s) are subject to oversight by the U.S. Environmental Protection Agency (EPA).

Joint Order

DEQ Order No. ECVC-NWR-00-27 (the Joint Order) dated October 4, 2000, requires NW Natural and Siltronic to, "…identify, characterize, and evaluate any unpermitted discharge or migration of contaminants to the Willamette River or its sediments identified in the RI, and, as necessary, develop and implement source control measures to address such releases." Under the Joint Order and consistent with the JSCS, DEQ considers both companies responsible for: 1) identifying complete contaminant transport pathways from the Siltronic Property to the Willamette River and sediment; and 2) evaluating SCMs alternatives for high priority pathways.

Currently, EPA and DEQ consider the off-shore areas of the Siltronic and NW Natural properties to be a potential candidate for early action. DEQ prioritized source control after determining it will be unlikely the uplands RI/FS of MGP waste and contamination on the NW Natural and Siltronic properties will be completed by the time the Record of Decision for Portland Harbor has been finalized (currently projected for 2010). As such, DEQ established short-term source control goals for the most heavily impacted portions of the Siltronic and NW Natural shorelines, including: 1) evaluating and selecting SCMs that effectively mitigate contaminant migration to the river; 2) expediting planning and design of the SCMs; 3) finalizing design(s) and implementing SCMs in coordination with EPA, but in advance of in-water action(s). DEQ considers the Groundwater/DNAPL FFS and VOC Plume FFS completed by NW Natural and Siltronic respectively, to have been prepared consistent with these goals.

DEQ also considers it a priority for the uplands MGP RI/FS to move forward concurrently with development and implementation of the SCMs. The MGP FS will include evaluation of proven, effective, and feasible remedial action alternatives for addressing MGP contamination in the uplands portions of the NW Natural and Siltronic properties. DEQ informed NW Natural and Siltronic that during the time it takes to complete uplands work, it is essential for the companies to select and implement compatible SCMs to meet the

requirements of the Joint Order, and the goals of the JSCS for MGP contamination and VOCs migrating to the river.

DNAPL/GROUNDWATER FOCUSED FEASIBLITY STUDY

DEQ's selection of SCMs alternatives, the conditions for moving forward with planning and design of SCMs, and our comments on the Groundwater/DNAPL FFS are provided below. Because source control-related work has been prioritized, DEQ's reviews of the Gasco Site RI Report and Baseline Risk Assessment are ongoing and a comments letter pertaining to both documents will be prepared subsequent to our review of the Groundwater/DNAPL FFS.

Given the status of the NW Natural and Siltronic properties in the Portland Harbor, DEQ provided copies of the Groundwater/DNAPL FFS to the EPA. In addition, the Oregon Department of State Lands (DSL) and the Tribe's shared consultant[11] requested copies. The DSL did not provide comments to the document. Copies of the EPA's and Tribe's consultant's comments are attached. In addition, given the DNAPL/Groundwater FFS proposes SCMs on the Siltronic Property, Siltronic provided comments to the document as well. Given EPA's role in the Portland Harbor, their February 8, 2008 letter should be of particular interest to NW Natural. The EPA provides comments directly applicable to the Groundwater/DNAPL FFS (see comments #1 [the third paragraph], #2,, #3, #4, #5, #6, and #8), and comments that NW Natural should address during the upland MGP RI/FS (see comments #1, #3, #6, and #7).

DEQ considered all of the reviewer's comments in preparing this letter, and although the DEQ, EPA, and Tribe's consultant share many comments, NW Natural should closely review the attachments so all comments are considered during preparation of future documents, when developing plans for SCMs, and during upland MGP RI/FS work.

The Groundwater/DNAPL FFS evaluates SCMs alternatives scenarios to control and contain DNAPL and contaminated groundwater along the shoreline of the NW Natural Property and the northern portion of the Siltronic Property (i.e., shoreline segments 1 and 2). Based on the results of the source control technologies screening evaluation presented in Section 6 of the document, vertical barriers and hydraulic control/containment were identified as SCMs alternatives for segments 1 and 2. DEQ accepts the outcome of the source control technology screening given the goals of the Groundwater/DNAPL FFS were to identify SCMs alternatives that are proven and effective at controlling and containing DNAPL and groundwater contamination and implementable within time-frame supportive of the uplands RI/FS schedule and future in-water actions. In addition, well-based hydraulic control/containment systems are operationally flexible and can be expanded depending on project need. DEQ also anticipates control/containment technologies will be a component of the final remedy because during, and for some time after, remediation of upland source areas, groundwater contamination will continue migrating towards the river and need to be intercepted.

NW Natural should be aware that given the SCMs alternatives evaluated in the Groundwater/DNAPL FFS do not address upland sources of contamination; DEQ does not recognize them being effective long-term remedial action alternatives for the MGP waste and MGP contamination on the Gasco Site and in the northern portion of the Siltronic Property. For clarification, DEQ regards many of the source control

[11] Stratus Consulting, Inc. reviewed the VOC Plume FFS on behalf of the Confederated Tribes of Grand Ronde, Siletz Department of Natural Resources, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of Warm Springs.

technologies dismissed as SCMs alternatives in the FFS to be legitimate remedial action alternatives for the upland FS. DEQ expects that an effective long-term remediation strategy of uplands source areas will involve combinations of remedial technologies (e.g., mass removal/reduction, containment, treatment) depending on the location, magnitude, nature, and extent of contamination.

NW Natural evaluated SCMs alternatives scenarios for both segments 1 and 2. The list of alternatives for the two segments was similar and generally included the following:

1. Alternative 1 – hydraulic control/containment alone;
2. Alternative 2 – rigid vertical barrier alone (based on the sheet-pile construction methodology);
3. Alternative 3 – non-rigid vertical barrier alone (based on the slurry wall method of construction);
4. Alternative 4 - hydraulic control/containment combined with a rigid barrier; and
5. Alternative 5 – hydraulic control/containment combined with a non-rigid barrier.

NW Natural further evaluated three variations of Alternative 4 and Alternative 5 for Segment 1 that involved varying the length (entire or partial length of Segment 1) and depth (65 feet or 85 feet below ground surface [bgs]) of vertical barrier(s).

In sections 7 and 8 of the Groundwater/DNAPL FFS, NW Natural compares each SCM alternative to DEQ balancing factors. In addition, NW Natural considered two other factors in the evaluation, including: 1) the ability of SCMs to prevent river recontamination, and 2) compatibility of SCMs with in-water actions. From review of the Groundwater/DNAPL FFS, DEQ further understands NW Natural's SCMs alternatives recommendations were influenced by the following significant technical findings.

1. Variation in depth of mobile DNAPL in the alluvial WBZ along Segment 1.
1. In the southern portion of the NW Natural Property, the lower elevation range of DNAPL occurrence is between approximately -42 and -50 feet mean sea level (msl), or roughly 4 to 12 feet below the navigation channel.
2. On the Siltronic portion of Segment 1, the upper elevation range of DNAPL occurs between approximately -72 and -82 feet msl (i.e., 32 to 42 feet below the bottom of the channel).
1. Absence of mobile DNAPL in the fill and alluvial WBZs along Segment 2.
2. Preliminary modeling work suggests the proposed hydraulic control/containment system can capture groundwater over the full thickness of the alluvial WBZ across both shoreline segments.

Based on the SCMs alternatives analysis, NW Natural recommended the following combination of SCMs in segments 1 and 2 (see Section 9):

3. Segment 1 - hydraulic control/containment using extraction wells along the entire segment combined with a vertical barrier that extends across the southern 625 feet of the NW Natural Property and constructed to a depth equivalent of approximately -40 msl (Alternative 4C); and
4. Segment 2 – hydraulic control and containment using extraction wells across the entire segment (Alternative 1).

NW Natural indicates in Section 9 the recommended SCMs alternatives that scored the highest are proven and implementable, and will effectively meet the source control RAOs by: 1) completely capturing, controlling, and containing groundwater contaminated by MGP constituents over the full thickness of the alluvial WBZ beneath shoreline segments 1 and 2; and 2) placing a vertical barrier across the portion of shoreline segments 1 and 2 where DNAPL has the highest potential to migrate to the Willamette River. Additionally, the recommended SCMs alternatives include VOCs where commingling of these chemicals with DNAPL and/or groundwater contaminated by MGP constituents has occurred.

Source Control Measures Evaluation and Selection

Based on review of the Groundwater/DNAPL FFS, DEQ agrees with NW Natural's recommended SCMs for Segment 1 (Alternative 4C) and Segment 2 (Alternative 1). For clarification, DEQ is only approving the general application of these technologies, and not the details implied by supporting discussions and figures presented in the document. The details and design of SCMs including the length, depth, alignment, and construction method(s) for the vertical barrier, and the numbers, locations, and depths of extraction wells will be determined subsequent to completion of additional field investigations and data review and analysis. Additional investigations are needed to further delineate the distribution of DNAPL near the shoreline (e.g., subsurface geologic and DNAPL logging), evaluate barrier construction methods (e.g., vibration testing, geotechnical studies), and support overall SCMs design (e.g., groundwater modeling).

DEQ does not approve of the riverbank stabilization proposal provided in Appendix F for reasons discussed further under "General Comments."

Source Control Measures Planning and Design

NW Natural should move forward with the work necessary to design the Segment 1 and Segment 2 SCMs subject to the conditions provided below. Many of the conditions reflect DEQ's review of the Targost® work completed in August-September 2007. Targost® logging equipment was used to support the SCMs alternatives evaluation, and the data was presented for the first time in the Groundwater/DNAPL FFS. Use of the Targost® equipment provided data to confirm the former effluent ponds are sources of mobile DNAPL to the fill WBZ and alluvial WBZ, and further characterize the horizontal and vertical distribution of DNAPL within Segment 1. The investigation also documents that DNAPL has migrated away from former effluent ponds towards the river and vertically downward. DEQ concludes based on the Targost® work that the hydraulic control/containment SCMs could potentially mobilize and spread DNAPL. DEQ previously informed NW Natural that potential expansion of the distribution of DNAPL is a significant factor for SCMs planning and design. As a consequence of these findings, DEQ expects NW Natural to do the following.

1. The RAO for Segment 1 should be revised to:
1. Clarify that SCMs alternatives have been evaluated specific to mitigating migration to the Willamette River along shoreline segments 1 and 2 by DNAPL in the fill WBZ and alluvial WBZ, and contaminated groundwater in the alluvial WBZ. Groundwater in the fill WBZ is not addressed except as a consequence of constructing the vertical barrier (see the second bullet in the second group of bulleted items below).
2. Include DNAPL removal to the extent necessary to control and contain the potential movement of DNAPL from former effluent ponds on the NW Natural and Siltronic properties that could result from operation of the hydraulic control/containment system.
3. Additional Targost® work should be performed to further evaluate the horizontal and vertical extent of DNAPL in areas potentially influenced by operation of the hydraulic control/containment system, including, but not necessarily limited to:
1. Between borings TG-1 and TG-2 to refine the location of the northern end of the vertical barrier;
2. Beneath the effluent settling, discharge, and/or overflow ponds in the southern portion of the NW Natural Property and the northern portion of the Siltronic Property (e.g., between Targost® borings TG-7 and TG-8, TG-3S and TG-4S, at GP02-03, and southwest of TG-3S/TB-5S/TB-6S and TG-8).
1. In previous correspondence and meetings, DEQ informed NW Natural that technical justification is needed to validate their assumption that DNAPL occurring below the bottom of the channel will not migrate into the river. To date, NW Natural has not responded adequately to DEQ's request. Absent

a satisfactory analysis, DEQ will expect the initial design depth of the vertical barrier proposed in the southern portion of the NW Natural Property to be no less than 10 feet below the bottom of the deepest occurrence of DNAPL (i.e., approximately -60 feet msl). See DEQ's specific comment to "Sections 6.2.1, 6.6.1, and 7.1.2.1 (and elsewhere)" for additional information.

DEQ acknowledges the Groundwater/DNAPL FFS has been prepared to evaluate SCMs alternatives and is not intended as a design document. However, DEQ will expect the following design elements and technical evaluations to be included in vertical barrier construction planning.

1. The SCMs alternatives evaluation presented in the Groundwater/DNAPL FFS focused on sheet pile and slurry wall construction methods. DEQ understands that the sheet pile construction method is preferred by NW Natural. NW Natural and Siltronic acknowledge the potential exists for sound and vibrations caused by driving sheet piles to negatively impact Siltronic's operations. The two companies are currently developing approaches for conducting and monitoring tests to assess potential vibration effects. For clarification, DEQ expects additional construction methods (e.g., poured piles, deep soil mixing) to be included in the vibration testing and monitoring plans being prepared. Additional discussion of this condition is provided in DEQ's comment to Section 3.3.4.

2. The vertical barrier alignment crosses the former source of direct discharges to the TBRA. As such, the barrier will be constructed through fill material heavily impacted by MGP waste. Given this information, engineering controls will be needed in the fill WBZ on the upland side of the barrier to prevent DNAPL and/or contaminated groundwater from moving over or around the barrier (e.g., fully penetrating DNAPL/groundwater collection trench in the fill WBZ).

3. Regardless of the construction method used, the barrier will require drilling and/or excavating through fill that is heavily impacted by MGP waste. DEQ will expect a method to be developed to effectively seal the fill from the underlying alluvium during construction to minimize cross-contamination (e.g., chemically compatible slurry-filled trench or pilot holes).

4. Along the alignment of the vertical barrier, NW Natural proposes to position extraction wells below the bottom of the vertical barrier. According to NW Natural, the vertical barrier will block lateral movement of mobile DNAPL towards the river, and extraction wells will reverse the hydraulic gradient and induce groundwater to flow from the river back towards the uplands. NW Natural asserts that gradient reversal will prevent mobile DNAPL from migrating to the river. DEQ does not approve this approach as the extraction wells are placed below the barrier and DNAPL, increasing the potential for coalescence and downward vertical migration of DNAPL. The vertical barrier should be fully integrated into the hydraulic control/containment system by placing additional extraction wells above the bottom of the barrier. This arrangement will increase horizontal and upward vertical gradients operating behind the barrier, and reduce the likelihood DNAPL will migrate below and beyond the influence of deeper extraction wells.

5. From a conventional standpoint the vertical barrier proposed by NW Natural is a "hanging wall" (i.e., a vertical barrier that is not keyed into low permeability material at depth). However, the stratigraphy of the alluvium beneath the silt unit along Segment 1 is variable, consisting of mixtures of fine and medium sand with lesser amounts of silt. DEQ will expect NW Natural to conduct a detailed analysis of available information (e.g., boring logs, grain-size analyses, CPT logs) to evaluate whether there are fine-grained layers, or packages of fine-grained sediments of overall lower permeability that could serve as a "key" for the bottom of the barrier. NW Natural should be aware that based on the review of available information, DEQ could require additional field data collection (e.g., collect samples for vertical permeability testing) to further evaluate this situation.

DEQ also has conditions regarding effectiveness monitoring and riverbank work that NW Natural should incorporate into SCMs planning and design.

6. Section 11.2 provides NW Natural's general recommendations regarding SCMs effectiveness monitoring. DEQ concurs with NW Natural that the monitoring program should be designed to monitor SCMs performance and determine whether the RAOs are being achieved. NW Natural indicates that this should involve measuring physical parameters only, primarily groundwater and DNAPL levels in extraction and monitoring wells. Regarding the hydraulic element of the performance monitoring program, DEQ expects additional installations will be needed and recommends NW Natural consult with recently published EPA guidance[12] regarding this topic.

DEQ disagrees with NW Natural that chemical measures are not needed to monitor SCMs performance. DEQ acknowledges that because SCMs will be surrounded by MPG waste and MGP contamination, SCMs performance cannot be solely based on monitoring MGP constituent and/or VOC concentrations or trends. However, NW Natural and DEQ have discussed using chemical measures to evaluate physical control and containment of contaminated groundwater in the alluvial WBZ (i.e., DEQ "hot spot" levels and JSCS Table 3-1 criteria). DEQ expects these concentration criteria to be carried forward into SCMs planning and design work, and used as a basis for assessing performance. Furthermore, chemical monitoring will be required to evaluate the effectiveness of the groundwater treatment system in achieving discharge limits that are in development. Based on this information, DEQ considers chemical analysis of groundwater samples and physical measurements to be essential for monitoring SCMs performance. Chemical monitoring should include, but is not limited to, analyzing groundwater samples from extraction wells and/or monitoring wells for:

1. Typical field measured water quality parameters;
2. Inorganic analytes indicative of surface water and groundwater chemistry;
3. COI for the Gasco Site and Siltronic facility (e.g., polycyclic aromatic hydrocarbons; VOCs, metals);
4. All parameters on the groundwater treatment system discharge list, and
5. Any additional constituents that could influence extraction well and/or groundwater treatment system operation and performance.

Along with physical measurements, chemical monitoring is needed to provide data to assess the timing and degree of interaction between the extraction well network and the river, monitor concentrations trends at extraction wells, support evaluations of contaminant capture and mass removal estimates, and track groundwater extraction and treatment system performance and operations. Ultimately, sufficient physical and chemical data must be collected to determine SCMs are achieving performance objectives (e.g., full vertical capture of the alluvial WBZ, reversing groundwater gradients in the alluvial WBZ, controlling/containing DNAPL in the fill and alluvial WBZs and within former effluent ponds).

6. Planning, design, and implementation of the vertical barrier and hydraulic control/containment SCMs must take into consideration future riverbank work that could include bank repair, excavation and removal, replacement, and/or stabilization. DEQ considers it unacceptable for future riverbank work to interfere with construction of the vertical barrier, installation and/or operation of extraction wells and/or DNAPL/groundwater treatment system equipment, buildings, or piping. Likewise, SCMs should not limit NW Natural's ability to develop a complete and effective approach to stabilizing the riverbank and preventing erosion of contaminated soils. This condition is further discussed under "General Comments."

[12] U.S. Environmental Protection Agency, 2008, "A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems – EPA 600/R-08/003," January, a guidance document prepared for use by technical professionals involved in sites using pump and treat systems.

General Comments

The results of preliminary modeling presented in Appendix E indicate that 10 extraction wells installed to a depth of approximately 85 feet bgs and pumping at a rate greater than 14 gallons per minute (gpm) will completely capture groundwater over the vertical extent of the alluvial WBZ. DEQ considers this a significant finding of the Groundwater/DNAPL FFS that warrants additional analysis, including, but not necessarily limited to:

1. Documenting that the basalt underlying the alluvial WBZ can be represented as a "no flow boundary" (i.e., does not contribute water to the model) using data or published reports.
2. Using independent methods confirm that the total groundwater flux through the alluvial WBZ is approximately 200 gpm (i.e., the combined pumping rate of the extraction wells to achieve complete capture).
3. Explaining the apparent contradiction between the NW Natural's conclusion that the river caused rapid stabilization of drawdown observed during PW-04 performance tests, and modeling results that suggest complete vertical capture of alluvium is achievable.
4. Evaluating the increase in hydraulic conductivity with depth (10 feet/day versus 200 feet/day) as an alternative to the river as the cause of rapid drawdown stabilization observed during performance testing.
5. Hydraulic property assignments are not provided in tables or shown on figures, and should be for completeness. Without this information DEQ cannot assess how the data generated for the site have been used to construct the model.

These items require clarification to determine whether the preliminary model grid and input parameters adequately represent the groundwater system, and before the model is carried forward and used for future SCMs planning and design work.

Appendix F provides NW Natural's proposed evaluations of interim riverbank stabilization alternatives for the Gasco Site. The objective of the evaluation is to identify measures to stabilize the slope and control potential erosion of the bank and transport of the underlying impacted soil to the river. NW Natural describes riverbank stabilization measures as, "…interim measures that could become a permanent remedy for shoreline stabilization of soils pending agency approval." Depending on location along the shoreline, NW Natural proposes three general approaches for the riverbank, including no action, repairing existing riprap, and use of engineered slope stabilization technologies. DEQ considers the proposal incomplete for the following reasons:

1. Appendix F references documents containing analytical data for riverbank sampling work completed previously. The bank stabilization evaluation needs to provide the information for completeness. The evaluation should incorporate data for soil samples collected on or near the riverbank so DEQ can: 1) evaluate whether sufficient data are available for project planning; 2) determine whether data have been compared to appropriate screening criteria; and 3) review bank stabilization recommendations in the context of the nature and extent of soil impacts.
2. The recommendations focus on engineering improvements only, and do not assess measures (e.g., removal), or the need for measures to reduce riverbank soil contamination.
3. Section 2.1 of the proposal indicates that the combination of the vertical barrier and hydraulic control/containment SCMs will eliminate groundwater seepage through the riverbank. Based on DEQ's understanding of the conceptual site hydrogeologic model, the fill WBZ represents the source of groundwater seeping through the riverbank. Given the hydraulic control/containment system is constructed in the alluvial WBZ, it is unclear how elimination of seepage through the riverbank

would occur. Absent information, data, and/or analysis that the alluvial WBZ extraction wells will also control/contain the fill WBZ along the shoreline, DEQ will expect the bank stabilization project to include this as an RAO.

DEQ concurs with NW Natural that planning, design, and implementation of the vertical barrier and hydraulic control/containments system are higher priorities than, and should move forward separately from the riverbank work. DEQ notes in Section 1.3 of the riverbank proposal that, "…there are some reaches of the shoreline where subsequent bank stabilization measure could interfere with groundwater source control measures…" DEQ has made NW Natural's implementation of a vertical barrier and hydraulic control/containment system contingent on satisfying two conditions: 1) future riverbank work will not interfere with implementation of SCMs; and 2) the SCMs preserve maximum flexibility in accommodating the range of options for bank soil and river sediment removal and/or stabilization. NW Natural should revise and resubmit a bank stabilization proposal that incorporates DEQ comments. The revised proposal should include figures comparing the locations of SCMs, including treatment system buildings and piping, with setbacks needed to accommodate riverbank work areas. Prior to revising the document, DEQ and NW Natural should meet to discuss and clarify the project's scope, goals, and objectives.

Specific Comments

In addition to the conditions and general comments listed above, DEQ has specific comments regarding the Groundwater/DNAPL FFS. These comments relate to planning, design, and implementation of the vertical barrier and hydraulic control/containment combination and future submittals.

Section 2.2. DEQ agrees with NW Natural that the MGP FS will evaluate remedial action alternatives for uplands soils and surface water. DEQ also anticipates that the vertical barrier and hydraulic control and containment system will be components of the final remedy. NW Natural should be aware that the MGP FS will need to fully evaluate performance of these SCMs and compare them to other alternatives so that a final groundwater pathway remedy can be selected. DEQ has made it clear that these measures alone will not be sufficient as a final remedy as they do not involve removal and/or treatment of uplands source areas on the Gasco Site and the Siltronic Property (e.g., former effluent ponds).

Section 3.2.12. The second to the last paragraph of this section suggests the VOC Plume influences the mobilization of MGP contamination. As DEQ has indicated in previous correspondence, to support this supposition NW Natural needs to collect the appropriate DNAPL data (e.g., composition, viscosity, specific gravity, wettability, interfacial tensions, and saturations), calculate the concentration of VOCs needed to increase mobility, compare calculated concentrations for available data, and present the findings and conclusions to DEQ for review.

Section 3.3.2. See DEQ's comments to Appendix E.

Section 3.3.3. NW Natural indicates the absence of free cyanide in surface water signifies SCMs may be unnecessary, or that the objectives of source control should be revisited. DEQ disagrees with this assertion and considers it premature given that the forms, stability, and toxicity of cyanide compounds, as well as their mass loading to the river have yet to be determined and/or characterized.

Section 3.3.4. According to NW Natural, the feasibility or recommendation of a SCM can not be fully evaluated before vibration issues are resolved. Sheet piles are used to evaluate a rigid barrier SCM in the Groundwater/DNAPL FFS. DEQ considers this method to have a high potential for producing vibrations

relative to other methods. The scope of vibration testing should evaluate other construction methods with the goal of identifying alternatives that are effective, feasible, and implementable. Vibration will certainly factor into this evaluation. DEQ expects NW Natural to evaluate several barrier construction methods simultaneously so that in the event the use of steel sheet pile is restricted, an alternate method of barrier construction (slurry walls, poured pilings) can be substituted with little to no delay in the implementation of SCMs.

Section 4.0. NW Natural evaluates SCMs alternatives using DEQ balancing (and other) factors, but not by protectiveness, which is a primary factor in an FS. NW Natural should be advised that protectiveness will need to be included at some point in the future, likely when the final upland and/or in-water remedies are defined.

Section 4.2.1. NW Natural identifies controlling and containing DNAPL and groundwater migration to the river as the two primary physical goals for source control. The goal for groundwater is described as controlling groundwater gradients in the alluvial WBZ to "…result in near zero groundwater discharge to the river." NW Natural indicates in the second paragraph that, "…such level of control [near zero discharge] is not necessary to prevent dissolved plume migration to the river…" In later sections of the Groundwater/DNAPL FFS (see sections 7.7.1 and 8.8.1), NW Natural discusses the results of preliminary modeling that suggest complete vertical capture of the alluvial WBZ is achievable. For clarification, DEQ understands the goal of achieving complete capture of the alluvial WBZ will be carried forward into planning SCMs and developing the performance monitoring program based on the following information presented in the Groundwater/DNAPL FFS.

1. The hydraulic control/containment system shown in Figure 7 is configured for complete capture at extraction rates greater than 140 gpm; and
2. NW Natural indicates the system will be designed for much higher extraction rates.

Later in the fourth paragraph, NW Natural indicates that, "In general, if an interim source control alternative meets the primary removal action goals, it can be assumed that virtually no residual risk from groundwater/DNAPL source exists." The RAOs for the Groundwater/DNAPL FFS are to control and contain ongoing and future migration of DNAPL and contaminated groundwater to the river. As modified by the conditions in this letter, the RAOs also include removing DNAPL as necessary to achieve these objectives. Without treatment and/or removal of upland sources, particularly DNAPL, the implementation of SCMs will not reduce risk related to the contamination present in uplands soil and groundwater, and in sediments, TZW, and groundwater under the river will remain in-place essentially unaffected. Until upland source areas of contamination are remediated consistent with a site ROD, and in-water actions are completed, the risk of exposure to human health and ecological receptors in the uplands and in the river will exist.

Section 6.2.1. NW Natural indicates that the results of the Targost® logging work, "…do not indicate that the Site DNAPL occurs in thick pools…" DEQ disagrees with this interpretation. DEQ interprets the data to indicate that DNAPL has accumulated beneath former effluent ponds. Depending on location, DNAPL occurs nearly continuously over vertical depth intervals of many feet (e.g., TG-8, TG-3S). Furthermore the data indicate mobile DNAPL is migrating away from the ponds (horizontally and vertically). As discussed under DEQ's General Comments, based on the results of Targost® logging, the RAO for Segment 1 has been expanded to included DNAPL removal in selected areas to reduce DNAPL mobility. DEQ will also expect the upland site-wide FS to include remedial action alternatives that remove subsurface DNAPL.

Sections 6.2.1, 6.6.1, and 7.1.2.1 (and elsewhere). NW Natural asserts that: 1) gravitational forces will prevent DNAPL from migrating upward into the river, 2) the effective depth of the barrier should coincide with the bottom of the river channel; and 3) hydraulic gradient reversals resulting from the extraction well network will effectively control DNAPL movement. DEQ expects NW Natural to fully evaluate potential DNAPL mobility using reasonable site-specific ranges of DNAPL properties and occurrence, and horizontal and vertical gradients operating under natural and induced conditions. Critical or threshold gradients for horizontal and vertical DNAPL movement and safety factors should be determined and integrated into the analysis. The results should be presented graphically, including showing the distribution and occurrence of DNAPL relative to the horizontal and vertical extent of the hydraulic control/containment capture zone. Unless conclusive information, data, and/or analysis can be provided to justify an alternative completion depth, the bottom of the vertical barrier should be at least 10 feet below the deepest occurrence of DNAPL near the Gasco Site shoreline for planning purposes. The final depth will be based on the depth of occurrence, distribution, and mobility of DNAPL, the stratigraphy of the alluvium, and the vertical barrier construction method.

Section 6.6.1. NW Natural indicates that vertical barrier construction methods other than sheet pile and slurry wall are unproven, and have greater potential for gaps to occur in the barrier. DEQ considers alternative barrier construction methods (e.g., deep soil mixing, poured piles) to have advantages over the sheet pile approach. As noted by NW Natural, alternative methods can achieve greater depths than sheet pile, and more importantly, alternative methods are known to produce less vibration than sheet piles. As indicated above, DEQ will require alternative barrier construction methods to be retained for further evaluation during vibration testing, and SCMs planning and design.

NW Natural notes that the depth barrier construction methods can achieve is not factor because all reviewed technologies can reach the depth of the river bottom. As indicated above, DEQ is requiring the bottom of the vertical barrier to be placed at -60 feet msl for preliminary planning purposes. Construction methods should be evaluated against this depth criterion. As such, depth of implementation may still be a factor in the selection process.

Section 6.6.2. For clarification, NW Natural and DEQ discussed vertical barriers as being a proven DNAPL containment technology for MGP sites, and agreed it was feasible to implement the technology on the NW Natural and Siltronic properties. Furthermore, both parties agreed vertical barriers should be evaluated in the Groundwater/DNAPL FFS as a SCMs alternative.

Section 7.1.1. DEQ has requested additional information regarding the preliminary model developed for the Groundwater/DNAPL FFS. A significant finding of the modeling work is that groundwater in the alluvial WBZ can be completely captured. Groundwater treatment costs are dependent on both the total flow rate and contaminant mass. As such, it is important for NW Natural to verify the anticipated range of total pumping rates for the extraction well network (i.e., total groundwater flux through the alluvial WBZ) and the associated treatment costs.

Section 7.1.2. This section re-states NW Natural's perceived RAO of preventing DNAPL from directly discharging to the Willamette River. However, it is implied that continued migration of DNAPL to areas beneath the river is an acceptable condition. For clarification, DEQ considers DNAPL beneath the river to represent a potential ongoing source of dissolved-phase contamination that should be considered during in-water action planning.

Section 7.1.3. The formulation of the slurry mix, possibly including cement, should consider future remedial work at the site. For example, the strength of the slurry wall may need to support construction activities and/or future efforts to remove riverbank material.

Section 7.2.2.3. For clarification and planning purposes, DEQ has previously determined that historic releases of VOCs from Siltronic's Former UST System to soil and groundwater are F002 listed hazardous waste.

Sections 7.2.2 and 7.2.5. NW Natural indicates that groundwater extraction wells alone, "… would be expected to contain DNAPL due to these gradient changes." DEQ disagrees due to the difficulty involved in fully characterizing the distribution, occurrence, mobility, and movement of DNAPL. Adding extraction wells on upland side of the barrier and within effluent ponds reduces uncertainty and increases SCMs effectiveness through removal of DNAPL in source areas and increased gradient control.

Sections 7.2.3.3 and 10.0. Based on observations made during uplands and in-water drilling and sampling work, agitation of sediments during construction of the vertical barrier could cause NAPL releases into the river. NW Natural should be advised that at another Portland Harbor site (i.e., ARCO Bulk Terminal 22T [ECSI #1528]), the National Oceanic and Atmospheric Administration (NOAA) "required" coordination to minimize potential takes of Endangered Species Act fish caused by upland sheet pile wall installation (e.g., in-water contaminant releases due to vibrations) even though in-water-permitting was not required. DEQ will expect NW Natural to contact NOAA to discuss this scenario, and include contingencies for mitigating in-water releases caused by barrier construction in the draft design document.

Section 7.2.4.4. Regarding river recontamination, except for a slightly higher potential for gaps to occur, NW Natural indicates a slurry wall would perform identically to a sheet pile barrier. From an engineering standpoint, DEQ considers a slurry wall to be less compatible than a sheet pile wall with future remedial work potentially involving riverbank stabilization work and/or removal of heavily impacted soil and/or sediment riverward of the barrier.

Section 7.2.5. This section provides contradictory information regarding DNAPL mobility. NW Natural implies that density differences between DNAPL and water are so slight as to allow reliable containment by pumping wells. However, in Section 6.6.1 NW Natural indicates that density contrasts are large enough to prevent DNAPL from migrating upward into the river. Regardless, DEQ is expecting and evaluation of DNAPL mobility and movement to be performed during SCMs planning and design.

Section 7.3.3. DEQ acknowledges that there are existing structures and subsurface conditions along the shoreline that could interfere with SCMs construction. While they are implementation considerations, existing structures can be temporarily removed (e.g., catwalks) and/or realigned (piping) to accommodate construction. DEQ agrees with NW Natural that removal of subsurface obstructions will likely be required to prepare the shoreline for SCMs construction.

Section 7.4.2. DEQ's comments to Section 7.1.1 apply here.

Section 9.2.1. The last sentence of the third paragraph indicates that, "The only potential benefit of the wall is to block the flow of shallow DNAPL to the river." As stated in our General Comments, properly integrated into hydraulic control/containment SCM, the vertical barrier will enhance DNAPL control/containment by increasing horizontal and upward vertical gradients behind the structure and also provide some measure of reduced river water influx.

Section 11.1. DEQ concurs with NW Natural's plan to perform periodic inspections of the extraction wells. Based on DEQ's experience with pump and treat systems, it is likely scheduled maintenance of the wells and treatment system components will be needed to maintain operational efficiency and performance. NW Natural should evaluate the effect maintenance shut-downs will have on controlling and containing DNAPL and/or contaminated groundwater (e.g., break-through or bypass during maintenance periods).

Section 11.2. DEQ's General Comment regarding chemical measures and performance monitoring applies here.

Tables 2 and 5a. The effectiveness of "Physical Barriers" should be listed as "H" in Table 2, especially since in this document effectiveness also encompasses long-term reliability and implementation risk. It is not clear why monitored natural attenuation (MNA) is listed under "In Situ Biological Treatment" as it also appears in its own category at the end of the table.

For Segment 1 (Table 5a), it is not clear that effectiveness and reliability are independent of the barrier wall length and depth; see comments on Sections 3.3.4 and 6.2.2. These factors should be considered independent of cost and implementability factors (all balancing factors should be evaluated independent of other factors). This comment should be considered during preparation of the FS.

In general, DEQ had many questions regarding NW Natural's approach to SCMs alternatives scoring. These questions are not raised in this letter as DEQ concurred with NW Natural's general SCMs alternatives recommendations for segments 1 and 2. This topic will need to be discussed further prior to initiating the upland FS.

Figure 2, Figures 5-E1 through 5-E5, and Figure 6a. Groundwater analytical data and DNAPL observations from the MW-16 and MW-18 monitoring well clusters are used in each of these figures. There appears to be a discrepancy regarding the thickness of DNAPL depicted by Figure 2 and figures 5-E1 through 5-E5 and Figure 6a. Figure 2 indicates that approximately 45 feet of DNAPL was observed, whereas figures 5-E1 through 5-E5 and Figure 6a indicate roughly 20 feet. For completeness the figures should depict DNAPL occurring in the fill unit and the alluvium. The figures should be reviewed and revised as appropriate.

Figure 2, Figure 3, Figure 13, and Figure 14. These figures depict interpretations of subsurface geology along a nearshore transect (Figure 3) and along the top of the riverbank (figures 3, 13, and 14). Depending on boring location, the geology of the alluvial WBZ is shown as being predominantly "Sand to Sandy Silt" and "Silt to Sandy Silt" in varying proportions. DEQ recommends that NW Natural review these figures and revise them based on grain-size analyses. The figures as drawn do not illustrate the lateral and vertical distribution of the dominant material types noted in Section 3.2.1.1.1 (e.g., fine sand, medium sand). Revising the figures using grain-size analyses, would better represent the hydrostratigraphy of the alluvial WBZ. Additionally, from DEQ's understanding of the labeling scheme, it appears that the "Sand to Sandy Silt" label should be changed to "Sand to Silty Sand." Revisions to these figures should be included in the draft SCMs design report.

Figures 5-E1 through 5-E5 and 6a. These figures depict the vertical distribution of dissolved constituent concentrations and DNAPL along a subsurface profile extending from the uplands through the TBRA. The offshore projection of the profile extends between borings GS-06 and GS-07. Given its location, boring GS-07 should have been shown on the profile to present more representative data and observations of subsurface

contamination occurring in this portion of the Gasco Site. Boring GS-07 should replace GS-06 on these figures for future submittals.

Figures 5-F1 through 5-F5. According to these figures DNAPL was not measured during the Targost® logging work completed at boring TG-8. However, the data log provided in Appendix G shows that over 24 feet of DNAPL was measured at that boring location. The referenced figures should be revised for future documents.

Figures 6a and 6b. In many sections of the Groundwater/DNAPL FFS the depth of occurrence of DNAPL is discussed in terms of the bottom of the river channel. For completeness, these figures should be revised by projecting the interpreted upper sediment surface out to the navigation channel. In addition, a profile through TG-08 (revised per the comment above), the PW-04 extraction well pair, the MW05 monitoring well cluster, MW20-120, and GP-09 should be added to this group of figures for the draft SCMs design report.

Figure 8. It is not clear to DEQ whether the extraction well system capture zone reflects the presence of a vertical barrier or not, and whether the capture zones are is representative of steady-state or transient conditions. The different lengths of particle tracks suggest the figure shows the extent of capture at multiple times. If the figure depicts transient conditions, the development of capture zones with the corresponding time(s) since pumping started should be provided on the figure.

Appendix A. Monitoring well WS21-112 is missing from figures A-01 through A-41. These figures should be reviewed and revised for future submittals.

Appendix E. Boring logs and/or construction information for extraction wells PW04-85 and PW04-118 are not provided in the appendix. Additionally, the data and analysis of the PW04-85 and PW04-118 performance tests appear to be incomplete. According to the Pilot Program Report[13] approved by DEQ, ten monitoring wells were selected for use as observation wells during the performance tests (see Table 5, Pilot Program Report). Although post-pumping hydrographs are presented for these wells (Figure 2-1, Appendix E), only five wells are used to analyze the actual performance tests. Water level data and data analysis from the only fill WBZ installation (MW05-32), two of the new monitoring wells installed to monitor the tests (MW19-125, MW19-180), and the nearest Siltronic monitoring wells (WS14-125, WS14-160) to the PW04 pair are not included. Assessing the influence of pumping the wells on water levels in the fill WBZ, and the results of time-series groundwater sampling are also not discussed.

Lastly, DEQ requests the figures 4-3 and 4-4 be revised to show the input parameters used for the model. This information is necessary to evaluate how the hydraulic properties of the alluvial WBZ were used to construct the model.

NW Natural should provide the information and data described above in the "pilot well report" being prepared.

NEXT STEPS

DEQ is not requiring the Groundwater/DNAPL FFS to be revised and resubmitted at this time. DEQ will require that NW Natural confirm in writing that the conditions and comments included in this letter will be

[13] Anchor Environmental, LLC, 2007, "Groundwater/NAPL Pilot Program, Extraction Well and Performance Evaluation Design Report," May (amended July 5, 2007), a report prepared for NW Natural.

addressed in the draft SCMs design document. The cover letter to the draft design document should clearly indicate how DEQ's conditions and comments have been incorporated into the submittal. In addition, prior to initiating work on the draft design document, NW Natural should fully respond to DEQ's General Comment regarding the preliminary groundwater model and update the overall schedule for SCMs planning, design, and implementation, and the upland RI/FS.

DEQ appreciates and acknowledges the significant amount of work NW Natural has conducted this passed year to support the Groundwater/DNAPL FFS for shoreline segments 1 and 2, including: 1) further evaluating the vertical and horizontal extent of groundwater contamination and DNAPL, 2) assessing the relationship between uplands groundwater impacts, and groundwater and TZW contamination beneath the river; and 3) collecting sediment and surface water data in the Willamette River. The work has identified a source control strategy for mitigating contamination migrating to the river along the shoreline of the NW Natural Property and the northern portion of the Siltronic Property, including the most heavily impacted shoreline segment.

Please call me at (503) 229-5543 if you have questions regarding this letter.

Sincerely,

Dana Bayuk, Project Manager
NWR Cleanup Section

Attachment: EPA February 8, 2008 letter
Stratus December 19, 2007 memorandum

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Matt McClincy, DEQ/PHS
ECSI file nos. 84 and 183